K24P 0868

Reg. No. : .....

Name : .....

Second Semester M.Sc. Degree (CBSS – Supple. (One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 to 2022 Admissions)
PHYSICS
PHY2C08 : Statistical Mechanics

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b**).

1. a) Describe the thermodynamic potentials and relationship among them. Obtain the Maxwell's equations of thermodynamics.

   OR

   b) For a system in thermal equilibrium with the surrounding obtain the canonical distribution. Hence obtain the expressions for internal energy, Helmholtz's free energy, entropy and pressure.

2. a) Discuss the thermodynamics of an ideal Bose gas and hence obtain Bose-Einstein condensate.

   OR

   b) Briefly discuss Pauli para magnetism and Landau diamagnetism. **(2×12=24)**

SECTION – B

Answer **any four** questions (**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

3. a) Give two examples of intensive thermodynamic variables.
   b) Write down the Gibbs-Duhem relation. What is its relevance ?
   c) The entropy of a certain system is given by the expression $S = B(NVU)^{\frac{1}{3}}$. Calculate the temperature and pressure of the system. S-entropy, U-internal energy, V-volume and N-number of particles. B is a constant.

4. a) What is the postulate of "equal a priori probabilities" ?

   b) Write down the Maxwell-Boltzmann velocity distribution. Draw the distribution function.

   c) A thermodynamic system of three energy levels $E_1 = 0$, $E_2 = 1$, $E_3 = 2$ has two Bosons and total energy 2. Calculate the entropy.

5. a) What do you know about the potential energy of a system of particles in an ideal gas ?

   b) Obtain the Grand Partition function of a system of quantum harmonic oscillators. Hence find the internal energy of the system.

   c) Calculate the average energy of a three-dimensional classical harmonic oscillator in thermal equilibrium with the surroundings at temperature T.

6. a) Define Fermi energy at absolute zero temperature.

   b) Considering photons as bosons in thermal equilibrium, obtain black body distribution law. Draw the distribution function at different temperatures.

   c) Calculate the total Magnetic moment M of a system of N non interacting spin $\frac{1}{2}$ particles in an external magnetic field H. Draw M as a function of H.

7. a) What is exchange energy ?

   b) Describe lattice gas.

   c) A certain system at temperature T has N number of particles. Each particle can independently occupy two energy states with energy $E_1 = 0$, $E_2 = E$. Calculate the specific heat of the system.

8. a) What is the difference between first order and second order phase transitions ?

   b) Briefly explain Landau's theory of phase transition.

   c) Discuss the general features of Ising Model. **(4×9=36)**

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